Genetic Correlations for Claw Health Traits between Nordic Countries and the Netherlands

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Abstract

Claw health is an important health issue in the dairy sector in Europe. The purpose of this study was to compare the breeding values for claw health traits between Denmark and the Netherlands. That is done by estimating genetic correlations between claw health breeding values of comparable traits. Correlations are estimated following the Interbull procedure for Multiple-trait Across Country Evaluation (MACE). Genetic correlations between the countries are very high, that indicate that the traits are comparable. There are more countries working on the introduction of breeding values for claw health traits. Potentially in the future conversions for claw health traits can be developed.

Key words: claw health traits, genetic correlation, Nordic countries, the Netherlands

Introduction

Claw health is an important health issue in dairy herds. More than 70% of the cows have at least one claw disorder (Somers *et al.*, 2003; Van der Waaij *et al.*, 2005, Capion *et al.*, 2009). Claw health has a negative impact on the welfare of an animal. Besides that it is responsible for economic losses, directly due to costs of treatment, extra labor costs, and indirectly due to loss of milk production and early culling. The economic losses due to claw disorders were estimated €192 for Danish circumstances (Ettema and Ostergaard, 2006) and €104 for Dutch circumstances (Enting *et al.*, 1997).

Claw disorders are affected by environmental factors, like housing and management routines. Those circumstances can differ between Nordic countries and the Netherlands. Besides external factors also genetic factors are influencing claw health. Claw disorders are heritable and there is genetic variation between animals that make selection for claw health possible. In the Nordic countries (Denmark, Finland and Sweden (DFS)) Breeding values for seven claw disorders are available since 2010 (Johannsson *et al.*, 2011) and the Netherlands (NLD) introduced breeding values for six claw health traits since 2010 (Van der Linde *et al.*, 2010). DFS and NLD also introduced an overall claw health index, to combine the claw health traits.

It is interesting to know if the ranking of bulls for claw health traits in Nordic countries is the same as the ranking in the Netherlands. The ranking is dependent on the definition of the trait, the data collection and the way of estimation the breeding values.

This study is focusing on comparability of breeding values for claw health traits between Nordic countries and the Netherlands, by estimating genetic correlations between claw health breeding values of comparable traits.

Materials and Methods

Data

In all countries data is gathered from professional claw trimmers, during trimming visits in the herd. Claw traits are following the ICAR claw health atlas (ICAR, 2015). Data collection started in 2003 in Sweden, 2004 in Finland, and 2010 in Denmark. Scored claw disorders in the DFS genetic evaluation are Dermatitis (interdigital and digital) (**DDE**), Sole hemorrhage (**SHE**), Sole ulcer (**SUL**), White line separation, double sole (**WLS**), Skin Proliferation: interdigital hyperplasia, wart (**SKP**), Heel Horn Erosion (**HHE**) and Cork screw claws (**CSC**). In the Netherlands data collection started routinely in 2006. The scored claw disorders are Digital dermatitis (**DD**),

Interdigital dermatitis (**IDD**), Sole hemorrhage (**SH**), Sole ulcer (**SU**), White line disease (**WLD**) and Interdigital hyperplasia (**HYP**). In 2016 about 15% of the Dutch cows are scored for claw health, and about 40% of the Nordic cow.

The study is based on breeding values of the national August 2015 evaluations. Table 1 gives an overview of the heritability of the traits, the total number of bulls with daughters with observations, the average reliability of the breeding value, the average number of daughters with observations per bull, and the average breeding value.

Table 1. Statistical information, heritability, number of bulls, reliability, and number of daughters.

Trait	h^2*	nr. bulls	Rel	Dau
NORDIC COUNTRIES				
CLW	0.04	3550	70	214
DDE	0.05	3482	71	154
SHE	0.02	3456	65	155
SUL	0.04	3486	68	157
WLS	0.02	3263	63	164
SKP	0.06	3251	72	160
HHE	0.04	3224	68	123
CSC	0.01	2453	56	174
THE NETHERLANDS				
CLW	0.07	1805	77	107
DD	0.09	1805	72	107
IDD	0.10	1805	73	107
SH	0.06	1805	68	107
SU	0.10	1805	70	107
WLD	0.03	1805	57	107
HYP	0.11	1805	69	107

*given as an average of the individual lactations.

Genetic correlations of comparable traits

To estimate the genetic correlations of comparable claw health traits the Interbull procedure for Multiple-trait Across Country Evaluation (MACE) method is applied (Sullivan and Wilton, 2001). The MACE method estimate genetic correlations bivariate based on national EBV's. The method combines information from Nordic countries and the Netherlands, by using all known relationships between animals, within and across the two populations. MACE procedure also takes genotype by environmental interactions in to account.

Results and Discussion

Comparable traits

Correlations are based on comparable traits between the countries, as well as on the overall claw health index. Comparable dermatitis traits are DDE with DD, and DDE with IDD. In the DFS evaluation interdigital dermatitis and digital dermatitis are presented in a combined breeding value for dermatitis. In the Dutch evaluation for both types of dermatitis a breeding value is available. Sole hemorrhage and sole ulcer are scored in both systems. White line separation and white line disease are comparable traits. Interdigital hyperplasia is part of the breeding value for skin proliferation, that makes SKP and HYP also comparable.

Genetic correlations

Estimates of the genetic correlation between comparable traits are given in table 2. Also the number of bulls with proofs in both countries is given in this table. For the overall claw health index the number of common bulls is with 338 bulls the highest. For this trait the average reliability of the common bulls for the overall claw health breeding value in Denmark is 75% and for the Netherlands 87%.

Table 2. Genetic correlation of comparable traits, number of common bulls, average reliability of the common bulls.

Trait			Common bulls		
DFS	**NLD**	**Gen cor**	**nr bull**	**rel DFS**	**rel NLD**
CLW	CLW	0.91	338	75	87
DDE	DD	0.99	335	76	83
DDE	IDD	0.93	335	76	84
SHE	SH	1.00	323	71	82
SUL	SU	0.95	336	73	83
WLS	WLD	0.95	309	70	73
SKP	HYP	0.98	334	76	81

The correlations between all trait combinations tested are high. The lowest correlation (0.91) is estimated between the overall claw health index of DFS and the overall claw health index of NLD. The scatterplot based on national breeding values for the claw health indices is given in Figure 1.

The highest correlation (1.00) is estimated between the breeding values for Sole hemorrhage in Nordic countries and the Netherlands. This indicates that the sole hemorrhage measured in NLD and DFS is genetically the same trait. The scatterplot for sole hemorrhage is given in figure 2. Based on the R^2 a correlation between the traits of 0.6 is expected. This correlation includes also breeding values with a low reliability around 40%. The correlation is lower compared to the MACE correlation, because in the reliability and genetic background are not taken into account in those correlations. Although only bulls with a reliability of 90% or higher are included, simple backwards calculations indicates that genetic correlations between EBVs for common bulls of 0.8 are still possible. The scatterplots for the digital dermatitis traits are given in figure 3 and figure 4. Figure 3 shows that the national breeding values for dermatitis in Nordic countries are very comparable with the Dutch Digital Dermatitis breeding values. The scatterplot for sole ulcer is given in figure 5, for white line abnormalities in figure 6 and for skin proliferations and hyperplasia in figure 7.

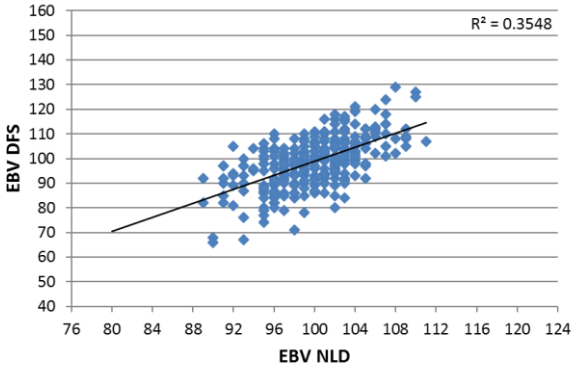

Figure 2. Correlation between Sole Hemorrhage in Nordic countries and Sole Hemorrhage in the Netherlands.

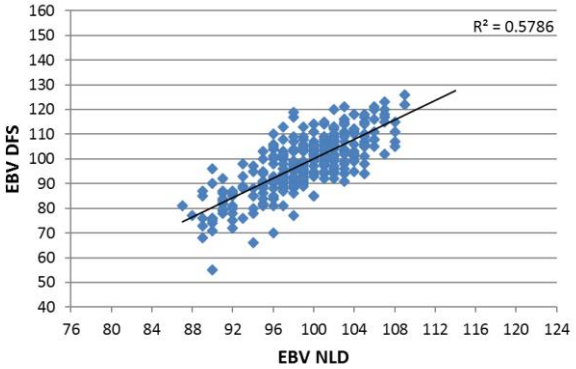

Figure 3. Correlation between dermatitis in Nordic countries and Digital Dermatitis in the Netherlands.

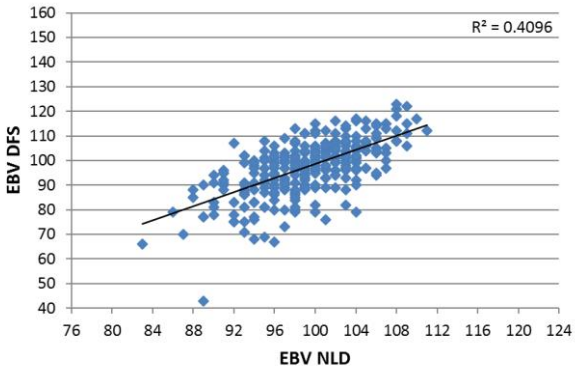

Figure 1. Correlation between claw health index in Nordic countries and the Netherlands.

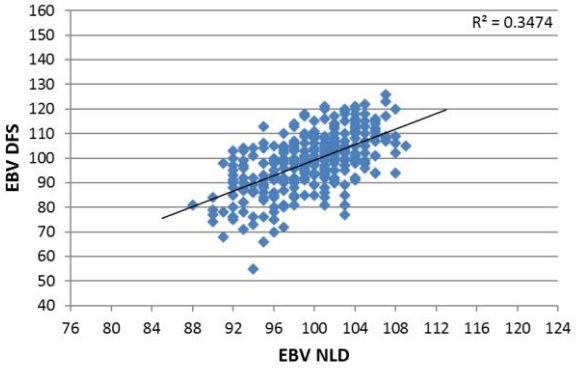

Figure 4. Correlation between dermatitis in Nordic countries and Interdigital Dermatitis in the Netherlands.

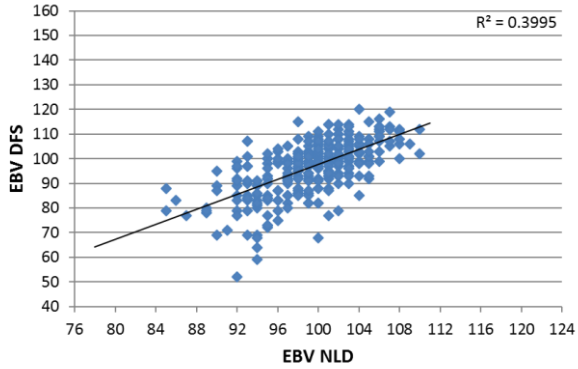

Figure 5. Correlation between Sole ulcer in Nordic countries and Sole ulcer in the Netherlands.

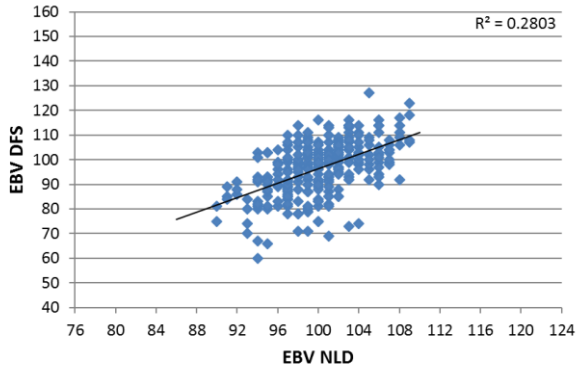

Figure 6. Correlation between White line separation in Nordic countries and White line disease in the Netherlands.

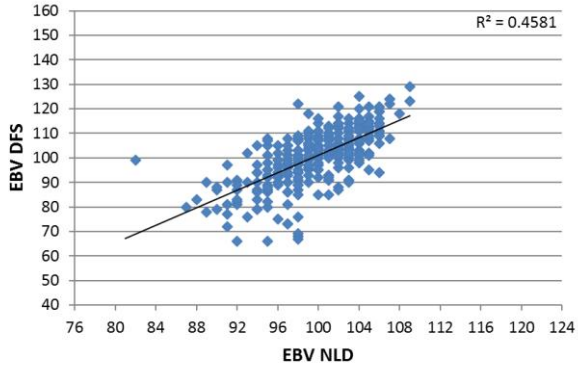

Figure 7. Correlation between Skin proliferation in Nordic countries and Interdigital hyperplasia in the Netherlands.

Conclusions

Estimates of Genetic correlation between DFS and NLD for claw health traits are very high (>90%). Possible estimates are a little overestimated, but they are still high. Simple backwards calculations based on reliabilities indicates that genetic correlations between EBVs for common bulls of 0.8 are still possible.

This study shows potential possibilities to make conversions between countries, when more countries have introduced a routine genetic evaluation for claw health.

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